

ALGEBRA

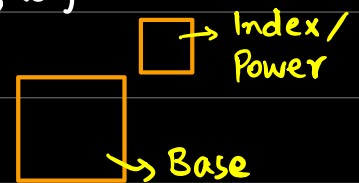
(20-25 Marks)

- P2 Algebra*
- ① ✓ 1- Indices (P1)
 - ② ✓ 2- Factorization (P1)
 - [✓ 3- Quadratic Equation Solving. (P2)
 - [✓ 4- Making Subject.
 - ④ ✓ 5- Simultaneous Eq. (P1)
 - ③ ✓ 6- Functions. (P1)
 - ✓ 7- Algebraic Expansions (Most Important)

ALGEBRA

INDICES (4 Marks)

INDEX = POWER
INDICES = POWERS



$$\boxed{1} \quad a^m \times a^n = a^{m+n}$$

(Same bases) (Multiply) = (Powers added)

$$a^m \div a^n = a^{m-n}$$

(Same bases) (Divide) = (Powers subtract)

CAUTION

$$a^m + a^n = X$$

$$a^m - a^n = X$$

This cannot be simplified further.

GOLDEN RULE: ALL PROPERTIES OF INDICES ONLY WORK FOR MULTIPLY / DIVIDE

Example:

$$1) 2^3 \times 2^5 = 2^{3+5} = 2^8$$

$$2) \frac{4^5}{4^2} = 4^{5-2} = 4^3$$

$$\boxed{2} a^m \times b^m = (a \times b)^m$$

$$\frac{a^m}{b^m} = \left(\frac{a}{b}\right)^m$$

If two different bases with same power are being multiplied/divided you can take power common

CAUTION

You are not allowed to take power common if terms are being add/sub

$$a^m + b^m = \cancel{(a+b)^m}$$

$$a^m - b^m = \cancel{(a-b)^m}$$

$$a^2 + b^2 = \cancel{(a+b)^2}$$

Base for Algebra:

$$(2x)^3 = 2^3 x^3 \quad \checkmark$$

$$\left(\frac{x}{2}\right)^4 = \frac{x^4}{2^4} \quad \checkmark$$

$$a^2 - b^2 = (a - b)^2$$

$$a^2 \times b^2 = (a \times b)^2 \checkmark$$

$$(4)^2 = 4^2$$

$$(x+3)^2 = x^2 + 3^2$$

$$(x-2)^2 = x^2 - 2^2$$

$$\boxed{3} \quad (a \times b)^m = a^m \times b^m$$

$$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$$

You are allowed to open power directly if terms are being multiplied/divided.

CAUTION:

YOU ARE NOT ALLOWED TO OPEN POWER DIRECTLY IF TERMS ARE BEING ADD/SUB

$$(a+b)^m = a^m + b^m$$

$$(a-b)^m = a^m - b^m$$

$$(x+4)^2 = x^2 + 4^2$$

$$(x+2)^2 - 2x = 5$$

$$x^2 + 2^2 - 2x = 5$$

This is wrong.

we open this using

$$(a+b)^2 = a^2 + 2ab + b^2$$

$$(a-b)^2 = a^2 - 2ab + b^2$$

we will learn to use these later.

$$\boxed{4} \quad (a^m)^n = a^{m \times n}$$

POWER KI POWER MULTIPLY HOGI

$$(x^3)^2 = x^{3 \times 2} = x^6$$

$\boxed{5}$ NEGATIVE POWERS

MATHS PPL HATE NEGATIVE POWERS.

$$a^{-m} = \frac{1}{a^m}$$

$$\left(\frac{a}{b}\right)^{-m} = \left(\frac{b}{a}\right)^m$$

If we reciprocate base, +/- sign of power changes.

Ex 1) $2^{-3} = \frac{1}{2^3} = \frac{1}{8}$

$$2) \left(\frac{2}{3}\right)^{-2} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$$

6

$$a^0 = 1$$

$$3^0 = 1$$

$$7^0 = 1$$

$$(-2)^0 = 1$$

0°
 → we do not like to talk about this.

Ex 1) $5^0 + 5^2 = 26$
 $1 + 25 =$

2) $4^0 - 4^{-2}$
 $1 - \frac{1}{4^2}$

$16 \times \frac{1}{16} - \frac{1}{16}$

$\frac{16-1}{16} = \frac{15}{16}$

3) $5^0 - 5^{-1}$
 $\frac{5 \times 1}{5 \times 1} - \frac{1}{5}$

$\frac{5-1}{5} = \frac{4}{5}$

7

$$1^{\text{any}} = 1$$

$$1^3 = 1$$

$$1^5 = 1$$

$$1^{-3} = 1$$

$$1^{3x-5} = 1$$

Q:

$$\frac{3^2 \times 1^k}{2^3}$$

$$\frac{9 \times 1}{8} = \frac{9}{8}$$

8 FRACTIONAL POWERS (SURDS)

$$\sqrt{x} = x^{\frac{1}{2}}$$

Fav. Power.

$$\sqrt[3]{x} = x^{\frac{1}{3}}$$

Method 1

$$1) 8^{\frac{2}{3}} = (2^3)^{\frac{2}{3}} = 2^{3 \times \frac{2}{3}} = 2^2 = 4$$

$$2) 64^{\frac{2}{3}} = (4^3)^{\frac{2}{3}} \\ = 4^{3 \times \frac{2}{3}} = 4^2 = 16$$

$$3) 64^{\frac{3}{2}} = (8^2)^{\frac{3}{2}} = 8^3 = 512$$

Method 2

$$1) 8^{\frac{2}{3}} = (8^{\frac{1}{3}})^2 = (\sqrt[3]{8})^2 = (2)^2 = 4$$

$$2) 64^{\frac{2}{3}} = (64^{\frac{1}{3}})^2 = (\sqrt[3]{64})^2 = (4)^2 = 16$$

$$3) 64^{\frac{3}{2}} = (64^{\frac{1}{2}})^3 \\ = (\sqrt{64})^3 \\ = (8)^3 = 512$$

9

$$x^{\frac{a}{b}} = y \Rightarrow x = y^{\frac{b}{a}}$$

When power goes to other side of = sign, it is reciprocated.

Ex 1) $x^{\frac{3}{2}} = 8$

$$\begin{aligned} x &= 8^{\frac{2}{3}} \\ &= (2^3)^{\frac{2}{3}} \\ &= 2^2 = 4 \end{aligned}$$

2)

$$x^2 = 16$$

$$x = \sqrt{16}$$

$$x = (16)^{\frac{1}{2}}$$

10 POWERS AND DECIMALS ARE NOT FRIENDS.

EX) 1) $(0.2)^{-2} = \left(\frac{2}{10}\right)^{-2} = \left(\frac{\cancel{10}^5}{\cancel{2}^1}\right)^2 = (5)^2 = 25$

2) $\sqrt[3]{0.008} = \sqrt[3]{\frac{8}{1000}} = \frac{\sqrt[3]{8}}{\sqrt[3]{1000}} = \frac{2}{10} = 0.2$

EQUATION SOLVING

1) $7^m \times 7^3 = 7^{12}$

$$\cancel{7}^{m+3} = \cancel{7}^{12}$$

$$m+3 = 12$$

$$m = 9$$

You can cancel base only if:

- 1) Single base
- 2) Same base.

2) $\frac{5^m}{5^4} = 125$

$$\cancel{5}^{m-4} = \cancel{5}^3$$

$$m-4 = 3$$

$$m = 7$$

$$3) 7^m \times 7^4 = 1$$

$$7^{m+4}$$

$$= 1$$

$$a^0 = 1$$

I need base to be 7

$$\cancel{7}^{m+4}$$

$$= \cancel{7}^0$$

$$7^0 = 1$$

$$m+4 = 0$$

$$m = -4$$

$$\frac{2^m \times 2^4}{2^8} = 1$$

$$2^8$$

$$\frac{2^{m+4}}{2^8}$$

$$= 1$$

$$2^8$$

$$2^{m+4-8}$$

$$= 1$$

$$\cancel{2}^{m-4}$$

$$= \cancel{2}^0$$

$$m-4 = 0$$

$$m = 4$$

4)

$$8^b = 2$$

$$(2^3)^b = 2$$

$$\cancel{2}^{3b} = \cancel{2}^1$$

$$3b = 1$$

$$b = \frac{1}{3}$$

Wrong Treatment

$$\cancel{2}^{3b} = \cancel{2}$$

$$3b = 0$$

$$b = 0$$

$$5) 10^c = 0.001$$

$$10^c = \frac{1}{1000}$$

$$10^c = \frac{1}{10^3}$$

$$\cancel{10}^c = \cancel{10}^{-3}$$

$$c = -3$$

5) Simplify $\left(\frac{18 x^2 y}{6 x y^5} \right)^{-2}$

Step 1: Simplify and
cancel everything
possible inside bracket.

$$\left(\frac{\overset{3}{\cancel{18}} \overset{1}{\cancel{x}} \overset{1}{\cancel{y}}}{\underset{6}{\cancel{6}} \underset{1}{\cancel{x}} \underset{5}{\cancel{y^5}}} \right)^{-2}$$

$$\left(\frac{3x}{y^4} \right)^{-2}$$

$$\left(\frac{y^4}{3x} \right)^2$$

$$\frac{(y^4)^2}{(3)^2 (x)^2}$$

$$\boxed{\frac{y^8}{9x^2}}$$

Step 2: open the power
directly on each term
and simplify.

6) $\left(\frac{16 x^7 y^2}{x^3 y^{10}} \right)^{\frac{1}{2}}$

$$\left(\frac{\overset{4}{\cancel{16}} \overset{7}{\cancel{x}} \overset{2}{\cancel{y^2}}}{\underset{3}{\cancel{x^3}} \underset{10}{\cancel{y^{10}}}} \right)^{\frac{1}{2}}$$

$$\left(\frac{16 x^4}{y^8} \right)^{\frac{1}{2}}$$

$$\frac{(16)^{\frac{1}{2}} (x^4)^{\frac{1}{2}}}{(y^8)^{\frac{1}{2}}}$$

$$\frac{(4^2)^{\frac{1}{2}} (x^1)^{\frac{1}{2}}}{(y^4)^{\frac{1}{2}}}$$

$$(4^2)^{\frac{1}{2}} (x^1)^{\frac{1}{2}}$$

$$\frac{4x^2}{y^4}$$

(4 MARKS)

FACTORIZATION

exp →

$$(a+b)^2 = a^2 + 2ab + b^2$$

$$(a-b)^2 = a^2 - 2ab + b^2$$

Ans: () ()

Factorize

$$a^2 - b^2 = (a+b)(a-b)$$

TWO TERMS

Step 1: Take common if possible

$$\text{Step 2: } a^2 - b^2 = (a+b)(a-b)$$

FACTORIZE

1 $4x - 10$
 $2(2x - 5)$

2 $x^2 - 9$
 $(x)^2 - (3)^2$
 $(x+3)(x-3)$

3 $1 - 16x^2$
 $(1)^2 - (4x)^2$
 $(1+4x)(1-4x)$

4 $5x^2 - 20$
 $5[x^2 - 4]$
 $5[(x)^2 - (2)^2]$
 $5[(x-2)(x+2)]$

5 $7x^2 - 63$
 $7[x^2 - 9]$
 $7[(x)^2 - (3)^2]$
 $7(x+3)(x-3)$

6 $4xy^3 + 16x^3y$
 $4xy[y^2 + 4x^2]$

THREE TERMS: MIDDLE TERM BREAKING

1 $x^2 + 7x + 12$

$$x^2 + 3x + 4x + 12$$

$$x(x+3) + 4(x+3)$$

$$(x+3)(x+4)$$

	1×12	
-	12	+
11	1×12	13
4	2×6	8
1	3×4	7

$$3 + 4 = 7$$

2

$$x^2 + 6x - 16$$

$$x^2 + 8x - 2x - 16$$

$$x(x+8) - 2(x+8)$$

$$(x+8)(x-2)$$

-	16	+
15	1x16	17
6	2x8	10
0	4x4	8
8-2 = 6		

Rule: If the first term of any group is negative, it is compulsory to take -ve common

When we take -ve common, signs inside bracket change.

3

$$x^2 - 12x + 20$$

$$x^2 - 2x - 10x + 20$$

$$x(x-2) - 10(x-2)$$

$$(x-10)(x-2)$$

-	20	+
19	1x20	21
8	2x10	12
1	4x5	9

$$2 + 10 = 12$$

$$-2 - 10 = -12$$

4 $\textcircled{1}x^2 - 2x - \textcircled{24}$

$$x^2 - 6x + 4x - 24$$

$$x(x-6) + 4(x-6)$$

$$(x-6)(x+4)$$

-	$\boxed{24}$	+
	1×24	
	2×12	
	3×8	
$\textcircled{2}$	4×6	
	$6 - 4 = 2$	
	$-6 + 4 = -2$	

5 $\textcircled{2}x^2 + 29x - \textcircled{15}$

$$2x^2 + 30x - 1x - 15$$

$$2x(x+15) - 1(x+15)$$

$$(x+15)(2x-1)$$

-	$\boxed{30}$	
29	1×30	
	2×15	
	3×10	
	5×6	
	$30 - 1 = 29$	

6 $\textcircled{1}x^2 - 4xy - \textcircled{12}y^2$

$$x^2 - 6xy + 2xy - 12y^2$$

$$x(x-6y) + 2y(x-6y)$$

$$(x-6y)(x+2y)$$

-	$\boxed{12}$	
	1×12	
$\textcircled{4}$	2×6	
	3×4	
	$6 - 2 = 4$	
	$-6 + 2 = -4$	

FOUR TERMS

Group and take Common.

Ex

$$ax + ay - bx - by$$

$$ax + ay - bx - by$$

$$a(x+y) - b(x+y)$$

$$(x+y)(a-b)$$

Some times there is no common in the groups. We have to rearrange the terms.

while rearranging always keep both positive terms first and then both negative term.

FACTORIZE

Ans () ()

SOLVE

$x = \square$, $x = \square$

Factorize:

$$\textcircled{1} x^2 - 7x + 12$$

$$x^2 - 3x - 4x + 12$$

$$x(x-3) - 4(x-3)$$

$$(x-3)(x-4)$$

$\boxed{12}$
 1×12
 2×6
 3×4
 $3+4=7$
 $-3-4=-7$

SOLVE

$$x^2 - 7x + 12 = 0$$

$$x^2 - 3x - 4x + 12 = 0$$

$$x(x-3) - 4(x-3) = 0$$

$$(x-3)(x-4) = 0$$

$\boxed{12}$
 1×12
 2×6
 3×4
 $3+4=7$
 $-3-4=-7$

Either

$$x-3=0$$

$$\boxed{x=3}$$

OR

$$x-4=0$$

$$\boxed{x=4}$$

Q. Solve. $(2x+3)(x-1) = 0$ (1Mark)

EITHER:

$$2x+3=0$$

$$2x=-3$$

$$\boxed{x = -\frac{3}{2}}$$

OR:

$$x-1=0$$

$$\boxed{x=1}$$

IMP

$$(x+3)(x-5) = 2$$

~~$$x+3=2 \quad \text{or} \quad x-5=2$$~~

THIS IS WRONG!

In this question first expand, bring 2 to left side, then factorize again.

$$(x+3)(x-5) = 2$$

$$x^2 - 5x + 3x - 15 = 2$$

$$x^2 - 2x - 17 = 0$$

Now the exam question will be solved using factorization.

QUADRATIC EQUATION SOLVING

$$ax^2 + bx + c = 0$$

FACTORIZATION	COMPLETED SQUARE	FORMULA.
Two terms:	$a(x-b)^2 + c$	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
1) Common		
2) $a^2 - b^2 = (a+b)(a-b)$	$\rightarrow a, b \text{ and } c \text{ are numbers}$	$\rightarrow$ Make sure you write formula and do detailed working to earn 4 Marks.
Three term:	$\rightarrow +/- \text{ signs can be different.}$	
Middle Term Break	$2(x-3)^2 + 5$	
	$2(x+3)^2 + 4$	
Four Terms:	$2(x-5)^2 - 2$	
Group and take common	$-3(x+5)^2 - 12$	
2-3 Marks	Only use completed square method when the first part of question requires to go to this form.	3-4 Marks
No mention of decimal places or significant figures		Question has specified decimal places or significant figures.

Q: Solve by factorization

(a) $x^2 - 6x - 16 = 0$

① $x^2 - 6x - 16 = 0$

$x^2 - 8x + 2x - 16 = 0$

$x(x-8) + 2(x-8) = 0$

$(x-8)(x+2) = 0$

$x-8=0$ or $x+2=0$

$x=8$

$x=-2$

16

1×16

2×8

4×4

$8-2=6$

$-8+2=-6$

2) $x^2 - 25 = 0$

$(x)^2 - (5)^2 = 0$

$(x+5)(x-5) = 0$

$x+5=0$ or $x-5=0$
 $x=-5$ or $x=5$

$x^2 - 25 = 0$

$x^2 = 25$

$x = \pm \sqrt{25}$

$x = \pm 5$

$x=5$ or $x=-5$

Q: Express $2x^2 - 12x + 10$ in form $a(x-b)^2 + c$
completed square form

$$2 \left[x^2 - 6x + (3)^2 - (3)^2 + 5 \right]$$

↗ Half

$$2 \left[(x-3)^2 - 9 + 5 \right]$$

$$2 \left[(x-3)^2 - 4 \right]$$

$$2(x-3)^2 - 8$$
$$a(x-b)^2 + c$$

$$a=2, \quad -b=-3, \quad c=-8$$
$$b=3$$

Q. Express $3x^2 + 24x + 30$ in form $a(x-b)^2 + c$
completed square form

$$3[x^2 + 8x + (4)^2 - (4)^2 + 10]$$

Half

$$3[(x + 4)^2 - 16 + 10]$$

$$3[(x+4)^2 - 6]$$

$$3(x+4)^2 - 18$$

$$a(x-b)^2 + c$$

$$a=3, \quad -b=4, \quad c=-18$$
$$b=-4$$

Q: Express $2x^2 - 20x + 7$ in form $a(x-b)^2 + c$

$$2 \left[x^2 - 10x + (5)^2 - (5)^2 + \frac{7}{2} \right]$$

$$2 \left[(x - 5)^2 - 25 + \frac{7}{2} \right]$$

$$\frac{7}{2} \times \frac{2}{2}$$

$$2(x-5)^2 - 50 + 7$$

$$2(x-5)^2 - 43$$

$$a(x-b)^2 + c$$

Q: Convert the following to form $a(x-b)^2 + c$

i) $2x^2 - 12x + 4$

$$2 \left[x^2 - 6x + (3)^2 - (3)^2 + 2 \right]$$

$$2 \left[(x - 3)^2 - 9 + 2 \right]$$

$$2 \left[(x - 3)^2 - 7 \right]$$

$$2(x-3)^2 - 14$$

$$a(x-b)^2 + c$$

$$a=2, \quad -b=-3, \quad c=-14$$

$$b=3$$

$$\text{ii)} \quad 3x^2 - 18x + 27$$

$$3[x^2 - 6x + (3)^2 - (3)^2 + 9]$$

$$3[(x-3)^2 - 9 + 9]$$

$$3[(x-3)^2]$$

$$3(x-3)^2$$

$$a(x-b)^2 + c$$

$$\text{iii)} \quad x^2 - 12x + 5$$

$$x^2 - 12x + (6)^2 - (6)^2 + 5$$

$$(x-6)^2 - 36 + 5$$

$$1(x-6)^2 - 31$$

$$a(x-b)^2 + c$$

$$iv) \quad 5x^2 + 40x - 10$$

$$5[x^2 + 8x + (4)^2 - (4)^2 - 2]$$

$$5[(x+4)^2 - 16 - 2]$$

$$5[(x+4)^2 - 18]$$

$$5(x+4)^2 - 90$$

$$a(x-b)^2 + c$$

$$v) \quad 3x^2 - 60x + 3$$

$$3[x^2 - 20x + (10)^2 - (10)^2 + 1]$$

$$3[(x-10)^2 - 100 + 1]$$

$$3[(x-10)^2 - 99]$$

$$3(x-10)^2 - 297$$

$$a(x-b)^2 + c$$

Q. (i) Express $x^2 - 6x + 3$ in form $\underline{(x-a)^2 - b}$
Comp. Sq. form.

$$x^2 - 6x + (3)^2 - (3)^2 + 3$$

$$(x - 3)^2 - 9 + 3$$

$$(x - 3)^2 - 6$$

$$x^2 - 6x + 3 \longrightarrow (x - 3)^2 - 6$$

(ii) Hence solve $x^2 - 6x + 3 = 0$ giving your answer in form $p \pm \sqrt{q}$ stating values of p and q .

$$x^2 - 6x + 3 = 0$$

$$(x - 3)^2 - 6 = 0$$

$$\sqrt{(x - 3)^2} = \pm \sqrt{6}$$

$$x - 3 = \pm \sqrt{6}$$

$$x = 3 \pm \sqrt{6}$$

$$p \pm \sqrt{q}$$

$$\boxed{p=3}, \boxed{q=6}$$

QUADRATIC FORMULA

$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Q. Solve $2x^2 - 3x - 1 = 0$ up to 2dp. (4)

$$a=2, b=-3, c=-1$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(2)(-1)}}{2(2)}$$

$$x = \frac{3 \pm \sqrt{17}}{4}$$

$$x = \frac{3 + \sqrt{17}}{4}$$

$$\text{or } x = \frac{3 - \sqrt{17}}{4}$$

CAUTION:

$$3 + \sqrt{17} \div 4$$

Wrong

$$(3 + \sqrt{17}) \div 4$$

Correct

$$x = 1.78$$

$$x = -0.28$$

Expansions

$$(a+b)^2 = a^2 + 2ab + b^2$$
$$(a-b)^2 = a^2 - 2ab + b^2$$

Factorize

$$a^2 - b^2 = (a+b)(a-b)$$

MOST IMPORTANT PAGE IN MATHS!

EXPANSIONS

Firstly:

$$(a+b)^2 = \cancel{a^2} + \cancel{b^2}$$
$$(a-b)^2 = \cancel{a^2} - \cancel{b^2}$$
$$(a \times b)^2 = a^2 \times b^2 \checkmark$$
$$\left(\frac{a}{b}\right)^2 = \frac{a^2}{b^2} \checkmark$$

Indices:

You are not allowed to open power directly if terms are being added/subtracted

So. Expand:

$$(a+b)^2 = a^2 + 2ab + b^2$$

$$(x+3)^2 = x^2 + 2(x)(3) + (3)^2$$
$$= x^2 + 6x + 9$$

$$(2x+5)^2 = (2x)^2 + 2(2x)(5) + (5)^2$$
$$= 4x^2 + 20x + 25$$

$$(3+4x)^2 = (3)^2 + 2(3)(4x) + (4x)^2$$
$$= 9 + 24x + 16x^2$$

$$(a-b)^2 = a^2 - 2ab + b^2$$

$$(x-3)^2 = (x)^2 - 2(x)(3) + (3)^2$$
$$= x^2 - 6x + 9$$

$$(2x-5)^2 = (2x)^2 - 2(2x)(5) + (5)^2$$
$$= 4x^2 - 20x + 25$$

MAKING SUBJECT OF FORMULA

TRICK: Term being made subject should be positive.

Q.: $y = \frac{3 - 2x}{5}$, Make x subject.

$$\begin{aligned} 5y &= 3 - 2x \\ 2x + 5y &= 3 \\ 2x &= 3 - 5y \\ x &= \frac{3 - 5y}{2} \end{aligned}$$

Make k the subject of the formula

$$\sqrt{\frac{h}{k}} = 3.$$

[2]

$$\left(\sqrt{\frac{h}{k}}\right)^2 = (3)^2$$

$$\sqrt{\frac{h}{k}} = 3$$

$$\frac{h}{k} = 9$$

$$h = 9k$$

$$\boxed{\frac{h}{9} = k}$$

Given that $T = 2\pi\sqrt{\frac{L}{g}}$,

express g in terms of π , T and L .

[3]

4024/02/O/N/06

$$T = 2\pi\sqrt{\frac{L}{g}}$$

$$\left(\frac{T}{2\pi}\right)^2 = \left(\sqrt{\frac{L}{g}}\right)^2$$

$$\frac{T^2}{4\pi^2} = \frac{L}{g}$$

$$T^2 g = 4\pi^2 L$$

$$g = \frac{4\pi^2 L}{T^2}$$

Make t the subject of the formula $p = \frac{4t+1}{2-t}$.

$$p(2-t) = 4t+1$$

$$2p - pt = 4t+1$$

$$2p-1 = 4t+pt$$

$$2p-1 = t(4+p)$$

$$\boxed{\frac{2p-1}{4+p} = t}$$

3 Mark

(P1) → Longest Question.

Answer [3]

(P1) 3 Marks = Longest question of paper

(P2) 3 Marks = Long question.

SIMULTAEIOUS EQUATIONS

ELIMINATION

Q. $2x + 3y = 5$
 $x - 4y = 12$

Q. $3x + y = 2$
 $x + 2y = 7$

SUBSTITUTION.

Q. $x + 2y = 3$
 $y = 9x - 3$

Q. $3x + 5y = 9$
 $2x = 3y.$

ELIMINATION

Solve the simultaneous equations

Lets make
y terms same

Same value
opposite signs.

$$\begin{aligned} (2x - y &= 16) \times 2 \\ 3x + 2y &= 17. \end{aligned}$$

$$\begin{array}{r} 4x - 2y = 32 \\ 3x + 2y = 17 \\ \hline 7x = 49 \end{array}$$

$$x = \frac{49}{7}$$

$x = 7$

$$3x + 2y = 17$$

$$3(7) + 2y = 17$$

$$2y = 17 - 21$$

$$2y = -4$$

$y = -2$

Answer $x = \dots\dots\dots$

$y = \dots\dots\dots$ [3]

Solve the simultaneous equations

$$3 \times (2x - y = 16)$$

$$2 \times (3x + 2y = 17)$$

$$6x - 3y = 48$$

$$6x + 4y = 34$$

$$-7y = 14$$

$$y = -2$$

$$2x - y = 16$$

$$2x - (-2) = 16$$

$$2x + 2 = 16$$

$$2x = 14$$

$$x = 7$$

Answer $x = \dots\dots\dots$

$y = \dots\dots\dots$ [3]

SUBSTITUTION

Solve the simultaneous equations

$$x + y = 29, \\ 4x = 95 - 2y.$$

$$x = 29 - y$$

$$4x = 95 - 2y$$

$$4(29 - y) = 95 - 2y$$

$$116 - 4y = 95 - 2y$$

$$116 - 95 = 4y - 2y$$

$$21 = 2y$$

$$y = \frac{21}{2} = 10.5$$

$$x = 29 - 10.5$$

$$x = 18.5$$

Solve the simultaneous equations

$$3x = 7y$$

$$12y = 5x - 1$$

$$x = \frac{7y}{3} = \frac{7(-3)}{3} = -7$$

$$12y = 5\left(\frac{7y}{3}\right) - 1$$

$$x = -7$$

$$12y = \frac{35y}{3} - 1$$

$$12y + 1 = \frac{35y}{3}$$

$$36y + 3 = 35y$$

$$36y - 35y = -3$$

$$y = -3$$

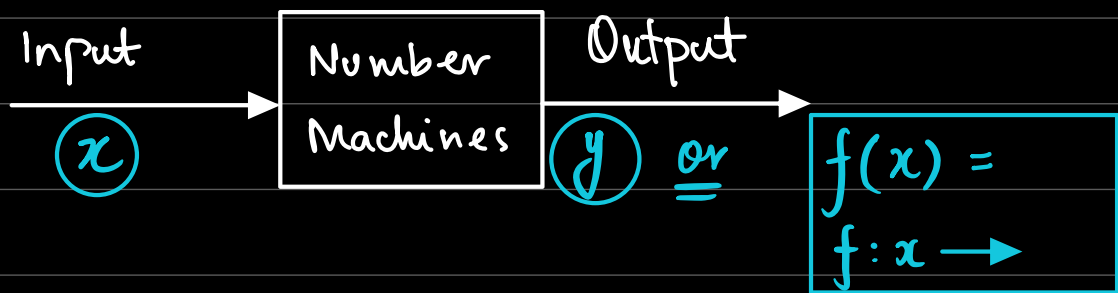
Answer $x = \dots\dots\dots$

$y = \dots\dots\dots$ [3]

FUNCTIONS

(4 MARKS) (P1)

For IGCSE, I will keep an extra class as well since they have bit more in syllabus.



$$f(x) = 2x + 5$$

name of function
value of input (x)

$$g(x) = x^2 + 3$$

$$1) f(3) = 2(3) + 5 = 11$$

$$5) g(t) = t^2 + 3$$

$$2) g(2) = (2)^2 + 3 = 7$$

$$6) f(k) = 2k + 5$$

$$3) f(10) = 2(10) + 5 = 25$$

$$7) f(t-3) = 2(t-3) + 5$$

$$4) g(5) = (5)^2 + 3 = 28$$

$$8) g(k+1) = (k+1)^2 + 3$$

TYPE 1

Q:

$$f(x) = 2x + 5$$

Given that $f(3) = t + 2$, find t .

$$f(3) = t + 2$$

$$2(3) + 5 = t + 2$$

$$11 = t + 2$$

$$t = 9$$

Q:

$$g(x) = 3x - 5$$

Given that $g(k) = 12$, find k .

$$g(k) = 12$$

$$3k - 5 = 12$$

$$3k = 17$$

$$k = \frac{17}{3}$$

Q.

$$f(x) = 4x - 3$$

Given that $f(t) = t$, find t .

$$f(t) = t$$

$$4t - 3 = t$$

$$4t = t + 3$$

$$4t - t = 3$$

$$3t = 3$$

$$t = 1$$

Q.

$$g(x) = 2x - 3$$

Given that $g(k) = k$, find k .

$$g(k) = k$$

$$2k - 3 = k$$

$$2k = k + 3$$

$$2k - k = 3$$

$$k = 3$$

Q.

$$f(x) = 3x + 7$$

Given that $f(3t+1) = 12t$ find t .

$$f(3t+1) = 12t$$

$$3(3t+1) + 7 = 12t$$

$$9t + 3 + 7 = 12t$$

$$10 = 12t - 9t$$

$$10 = 3t$$

$$t = \frac{10}{3}$$

INVERSE OF A FUNCTION

Symbol: $f^{-1}(x)$

STEPS:

1) Replace $f(x) \rightarrow y$

2) Make x subject

3) Replace $x \rightarrow f^{-1}(x)$
 $y \rightarrow x$

Q.

$$f(x) = 2x - 3$$

Find inverse.

$$y = 2x - 3$$

$$y + 3 = 2x$$

$$x = \frac{y + 3}{2}$$

$$\downarrow \qquad \downarrow$$

$$f^{-1}(x) = \frac{x + 3}{2}$$

Beware: $f(-1)$ means
put $x = -1$ in function
 $f(x)$

Q: $f(x) = 12 - 2x$, Find inverse.

$$y = 12 - 2x$$

$$y + 2x = 12$$

$$2x = 12 - y$$

$$x = \frac{12 - y}{2}$$

$$f^{-1}(x) = \frac{12 - x}{2}$$

Q: $f(x) = \frac{2x + 3}{5x}$ Find inverse.

$$y = \frac{2x + 3}{5x}$$

$$5xy = 2x + 3$$

$$5xy - 2x = 3$$

$$x(5y - 2) = 3$$

$$x = \frac{3}{5y - 2}$$